PHYS-241: PHYSICS FOR SCIENTISTS & ENGINEERS 3

Effective Term
Fall 2026

CC Approval
12/05/2026

AS Approval
12/11/2026

BOT Approval
12/18/2026

SECTION A - Course Data Elements

Send Workflow to Initiator
No

CB04 Credit Status
Credit - Degree Applicable

Discipline

Minimum Qualifications	And/Or
Physics/Astronomy (Master's Degree)	

Subject Code
PHYS - Physics

Course Number
241

Department
Physics

Division
Science and Engineering (SE)

Full Course Title
Physics for Scientists & Engineers 3

Short Title
Phys Scientists & Engineers 3

CB03 TOP Code
1902.00 - Physics, General

CIP Code
40.0801

CB08 Basic Skills Status
NBS - Not Basic Skills

CB09 SAM Code
E - Non-Occupational

Rationale
Fractional units (dangling units) fixed by coding of problem solving discussion as lecture. See appended faculty comments. Updates to textbook, small language improvements throughout.

SECTION B - Course Description

Catalog Course Description
This is a calculus-based introduction to electromagnetic waves, physical optics, relativity, and atomic and quantum physics. Topics include Maxwell's Equations and electromagnetic waves, light, lenses, diffraction and polarization, relativity, quantum mechanics, molecules and solids, nuclear physics and radioactivity, nuclear energy, elementary particles, and astrophysics and cosmology.

SECTION C - Conditions on Enrollment

Open Entry/Open Exit
No

Repeatability
Not Repeatable

Grading Options
Letter Grade or Pass/No Pass

Allow Audit
No

Requisites

Prerequisite(s)
Completion of PHYS-240 with a minimum grade of C.

Requisite Justification

Requisite Description
Course in a Sequence

Subject
PHYS

Course #
240

Level of Scrutiny
Content Review

Upon entering this course, students should be able to:
Completion of PHYS-240 with a minimum grade of C.

SECTION D - Course Standards

Is this course variable unit?
No

Units
4.00

Lecture Hours
36.00

Lab Hours
54.00

Activity Hours
36.00

Outside of Class Hours
90

Total Contact Hours
126

Total Student Hours
216

Distance Education Approval

Is this course offered through Distance Education?
Yes

Online Delivery Methods

DE Modalities	Permanent or Emergency Only?
Entirely Online	Permanent
Hybrid	Permanent
Online with Proctored Exams	Permanent

SECTION E - Course Content

Student Learning Outcomes

	Upon satisfactory completion of the course, students will be able to:
1.	Communicate the principles of electromagnetism, optics, relativity and quantum mechanics theory and how they relate to the macroscopic or microscopic realm. Solve problems on these topics using qualitative reasoning.
2.	Solve quantitative calculus level electromagnetic radiation and modern physics problems while demonstrating a thorough understanding of the application of Maxwell's, wave and particle theories.
3.	Implement laboratory experiment techniques correctly during the investigation of electromagnetic radiation, atomic and nuclear processes and express the results clearly in writing.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1.	Solve problems in wave motion including sound and standing waves.
2.	Find the energy and momentum of an electromagnetic wave.
3.	Calculate the magnification of a microscope or a telescope.
4.	Analyze situations involving interference and diffraction of light waves, and apply these to situations including double slits, diffraction gratings, and wide slits.
5.	Apply concepts from special relativity to analyze physical situations, including time dilation, length contraction, and the Lorentz transformation. Solve basic problems involving relativistic momentum and energy.
6.	Use the Exclusion Principle to derive the allowed quantum states of an atom.
7.	Use the Band Theory of Solids to explain electrical conduction in solids.
8.	Calculate the binding energy of a nucleus.
9.	Explain the fission and fusion processes in a hydrogen bomb.
10.	Analyze basic physical situations involving reflection and refraction and use this analysis to predict the path of a light ray. Equations and ray diagrams may be used.
11.	Apply basic concepts of quantum mechanics to analyze basic physical setups, including a particle in a box and simple atomic models.

Course Content

1. Wave Motion:
   a. Types of waves
   b. Superposition and interference of waves
   c. Reflection and transmission of waves
   d. Energy transmitted by sinusoidal waves on strings
2. Sound Waves
   a. Speed of sound waves
   b. Periodic sound waves

   c. Intensity of periodic sound waves
   d. The Doppler effect
3. Superposition and Standing Waves
   a. Superposition and interference of sinusoidal waves
   b. Standing waves
   c. Resonance
   d. Beats: Interference in time
4. Electromagnetic Waves
   a. Maxwell's equations and Hertz's discoveries
   b. Plane electromagnetic waves
   c. Energy carried by electromagnetic waves
   d. The spectrum of electromagnetic waves
5. The Nature of Light and the Laws of Geometric Optics
   a. Measurements of the speed of light
   b. Reflection and refraction: lenses, mirrors, optical instruments.
   c. Dispersion and prisms
   d. Total internal reflection
6. Geometric Optics
   a. Young's Double-Slit experiment
   b. Phasor addition of waves
   c. Change of phase due to reflection
   d. Interference in thin films
7. Diffraction and Polarization (Wave Optics and Physical Optics)
   a. Single-Slit diffraction
   b. Resolution of Single-Slit and circular apertures
   c. The diffraction grating
   d. Polarization of light waves
8. Relativity
   a. Einstein's Principle of Relativity
   b. Special relativity: The Lorentz Transformation Equations
   c. Relativistic momentum and the relativistic form of Newton's Laws
   d. Relativistic energy
9. Introduction to Quantum Physics
   a. Blackgody radiation and Planck's hypothesis
   b. The photoelectric effect
   c. The Compton Effect
   d. Bohr's quantum mod el of the atom
10. Quantum Mechanics
   a. Photons and electromagnetic waves
   b. The Uncertainty Principle
   c. The Schrodinger Equation
   d. Tunneling through a barrier
11. Atomic Physics
   a. The spin magnetic quantum number
   b. The wave functions for hydrogen
   c. The Exclusion Principle and the Periodic Table
   d. Atomic transitions
12. Condensed matter: Molecules and Solids
   a. Molecular bonds
   b. Bonding in solids
   c. Band theory of solids
   d. Free-electron theory of metals
13. Nuclear Structure
   a. Binding energy and nuclear forces
   b. Nuclear reactors
   c. Nuclear fusion
14. Fission and Fusion

a. Nuclear fission
b. Nuclear reactors
c. Nuclear fusion

15. Particle Physics
    a. Positrons and other antiparticles
    b. Classification of particles
    c. Strange particles and strangeness
    d. Quarks

Methods of Instruction

Methods of Instruction

Types	Examples of learning activities
Discussion	Classroom discussion of example problems. This may include demonstration by the instructor or student presentations on the whiteboard.
Lab	Physical and simulated laboratory experiments. Possible activities include: observation, use of equipment, data collection, data analysis, and interpretation of results.
Lecture	Presentation of course material using standard methods, for example but not limited to: speaking, work on the whiteboard, videos, lecture slides, and demonstrations.

Online Adaptation

Types	Examples of learning activities
Discussion	Synchronous or asynchronous class discussion of example problems. This may include discussion posts, demonstration of solved problems by the instructor, or students working in groups to solve problems.
Lab	Participation in lab simulations and/or analysis and observation of video experiments. Possible activities include: observation, simulated use of equipment, data collection, data analysis, and interpretation of results.
Lecture	Synchronous or asynchronous video lecture using standard methods which may include but are not limited to: speaking, lecture slides, demonstrations, and video footage of physical phenomena.

Instructor-Initiated Online Contact Types

Announcements/Bulletin Boards
Chat Rooms
Discussion Boards
E-mail Communication
Video or Teleconferencing

Student-Initiated Online Contact Types

Chat Rooms
Discussions
Group Work

Course design is accessible

Yes

Methods of Evaluation

Methods of Evaluation

Types	Examples of classroom assessments
Exams/Tests	Exams may consist of, for example, multiple choice questions, fill in the blank, conceptual questions, and symbolic and numerical problems.
Homework	Textbook problems. These include qualitative and quantitative solving of questions on the course material.
Lab Activities	Complete lab experiments and analysis. Examples of activities include observation, operation of real or simulated equipment, data collection, data analysis, and interpretation of results.

Projects	Projects may include submitted example problem solving generated in groups, review of student note taking, and submitted practice exam drafts.

Assignments

Reading Assignments

Textbook chapters.

Laboratory Manual experiments.

Sample Reading Assignment 1: Read Chapter 33 - Lenses and Optical Instruments.

Sample Reading Assignment 2: Read Experiment 17 - Polarized Light Malus's Law.

Writing Assignments

Example Lab Report Requirements:

1) Cover Page (Typed): Include Your Name, Lab Exp. #, Lab Title, Date, and list of Lab Partners.

2) Procedure (Typed): In your own words describe the general procedure(s) for this experiment. The procedure can be in an outline format, paragraphs, or any other way that can best convey the procedure used to carry out the experiment, make measurements, and obtain the required results. Please: Do Not Just Copy the Procedure from the Lab Manual.

3) Data Sheet(s) Section: Include your recorded lab data sheets. Do Not Forget to include units, correct number of significant figures, and make sure your entries are legible.

4) Graph Section: Any graphs assigned are to be done on the computer with software that includes Regression Analysis by the method of least squares. The regression equation must be printed on the top of the graph. Each graph must be labeled with a Title and Axes description with units.

5) Calculations Section: Hand calculations, which includes providing units for each factor, term and results. Any conversions or geometric calculations are to be included. Intermediate calculations are to be provided. Your goal should be to write up your calculations so someone else can understand them.

6) Question Answer Section (Typed): Answers to assigned lab questions must be typed and spell checked.

7) Analysis and Conclusion (Typed): In this section, you must critically analyze your results, experiment procedure, measurement techniques, and include a conclusion that explains if the experiment objectives were met or not. Explain why or why not. You are expected to show clear logic and understanding of the final results and their physical meaning.

Outside-of-Class Assignments

Homework Problems.

Sample Problem 1:

One of the beams of an interferometer passes through a small, evacuated glass container 1.155 cm deep. When a gas is allowed to slowly fill the container, a total of 187 dark fringes are counted to move past a reference line. The light used has a wavelength of 631.8 nm. Calculate the index of refraction of the gas at its final density, assuming that the interferometer is in vacuum.

Sample Problem 2:

How long must you wait (in half-lives) for a radioactive sample to drop to 1.00% of its original activity?

SECTION F - Textbooks and Instructional Materials

Material Type

Open Educational Resource (OER)

Author

Senior Editors S. J. Ling, J. Sanny, W. Moebs

Title

University Physics Volume 3

Edition/Version

Web Version

Publisher

OpenStax

Year

2025

ISBN #

ISBN-13: 978-1-938168-18-5

Material Type
Textbook

Author
Knight, Randall

Title
Physics for Scientists and Engineers: A Strategic Approach

Edition/Version
5th

Publisher
Pearson

Year
2022

Rationale
This is one example of a standard text.

ISBN #
978-0137344888

Material Type
Manual

Author
Wilson, D.P., Hernandez, C.A.

Title
Physics Laboratory Experiments 8th edition

Publisher
Cengage Learning

Year
2015

SECTION G - Diversity, Equity and Inclusivity

How does your course and/or course outline of record reflect strategies for accommodating and engaging diverse student populations, advancing equitable outcomes, and fostering inclusion for all students?
Multiple types of activities and content delivery are included. Courses include policies for flexible deadlines and/or lowest scores dropped. In class, students are referred to student support services.

Course Codes (Admin Only)

CB00 State ID
CCC000192628

CB10 Cooperative Work Experience Status
N - Is Not Part of a Cooperative Work Experience Education Program

CB11 Course Classification Status
Y - Credit Course

CB13 Special Class Status
N - The Course is Not an Approved Special Class

CB23 Funding Agency Category
Y - Not Applicable (Funding Not Used)

CB24 Program Course Status
Program Applicable

Allow Pass/No Pass
Yes

Only Pass/No Pass
No